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# Eastern Bering Sea (Bristol Bay) Coastal Research on Juvenile Salmon, August 2000

by

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## Abstract

An eastern Bering Sea research cruise was conducted by the Auke Bay Laboratory, Ocean Carrying Capacity program during August 2000 to study the early marine distribution, migration, and growth of juvenile sockeye salmon from Bristol Bay and early marine distribution and migration of juvenile chum salmon from the Kuskokwim River. Juvenile sockeye salmon were distributed in the middle domain of the eastern Bering Sea east of 166 ºW. The distribution differed from our September 1999 survey where large numbers of juvenile salmon were found within both the coastal and middle domains. These differences in distribution (habitat) between years may have played a vital role in increased early marine growth for juvenile sockeye salmon caught during August 2000 when compared to those caught during September 1999. The largest catch of juvenile chum salmon occurred in the coastal domain of the eastern Bering Sea south and west of the Kuskokwim River between 163 ºW and 164 ºW. Further sampling north, south, and east of Nunivak Island will be needed to determine early marine distribution and migration of juvenile chum salmon leaving the Kuskokwim River and entering the Bering Sea.

## Introduction

During August 2000, scientists from the Auke Bay Laboratory, Ocean Carrying Capacity (OCC) program conducted a survey of juvenile salmon distribution, migration, and growth along the coastal waters of the eastern Bering Sea. Annual surveys of the eastern Bering Sea by the OCC program were started during 1999 in response to substanially low returns of adult salmon to this region during 1997 and 1998. The cause of the reduced salmon returns to Bristol Bay during 1997 and 1998 is not fully understood, but may be related to changes in the marine environment. Fishery scientists generally agree that conditions in the ocean, particularly in the first few months after leaving freshwater, strongly influence interannual variability in salmon survival and growth (Parker 1962; Pearcy 1992). The assumption is that growth rates of juvenile salmon in the estuarine and nearshore marine environments are directly linked to their survival. Thus, favorable environmental conditions leading to increased growth rates of juvenile salmon may improve their early marine survival, and ultimately lead to increasing adult returns of salmon in the following years. The primary goal of the annual assessments is to establish and verify the linkages between adult sockeye salmon survival and annual variations in biological characteristics of juvenile sockeye salmon. A secondary goal of the August 2000 survey was to determine the seaward migration pathways of Kuskokwim River juvenile chum salmon as they enter the coastal waters of the Bering Sea.

## Methods

The OCC survey of the eastern Bering Sea was conducted during August 20 – September 2, 2000. The survey area ranged from 166 ºW to 162 ºW longitude (Figure 1). The cruise

itinerary and participating scientists are listed in Tables 1 and 2. Transects sampled during the survey were along longitudinal lines crossing coastal, middle, and outer domains of the eastern Bering Sea shelf (Figure 1). Sampling stations along each transect began and ended at nearshore locations within the coastal domain (Table 3).

The survey was conducted aboard the contracted fishing vessel (F/V) *Great Pacific*. The vessel is a 38-m stern trawler with a main engine of 1450 horsepower and a cruising speed of 10 kts. Fish samples were collected using a midwater rope trawl, which is 198 m long, has hexagonal mesh in wings and body, and has a 1.2-cm mesh liner in the codend. The rope trawl was towed at 4 to 5 kts, at or near surface, and had a typical spread of 44 m horizontally and 11 m vertically. All tows lasted 30 minutes and covered 2.8 to 4.6 km. All sampling was done during daylight hours.

Salmon and other fishes were sorted by species and counted. Standard biological measurements including fork length, body weight, and sex as well as scale samples from the preferred area (to document age and growth) were taken from subsamples of all salmon species. Juvenile chum and sockeye salmon were frozen whole at –60°C for genetic analyses. Otoliths from immature and maturing chum salmon were collected to document distribution and migration of hatchery salmon whose otoliths were thermally marked during incubation. Genetic tissues from immature and maturing chum salmon were also collected (frozen at –60°C) to document distribution of Pacific Rim stocks within our survey area. All other fish species were counted and biological measurements including length and body weight were taken from subsamples of each species. Stomachs were also removed from the subsamples and preserved in 10% formalin for laboratory analyses.

Oceanographic data were collected at each trawl station immediately prior to each trawl haul. Profiles of salinity and temperature from surface to near bottom depths were collected using a Sea-Bird SBE 19 Seacat profiler[1]. Plankton samples were collected using 60-cm diameter bongo samplers fitted with 505- and 333 μm mesh nets, respectively. The bongo nets were towed obliquely from near surface to approximately 10 m from the bottom; estimated depth of each bongo tow was calculated by wire angle and length of wire. Volume of water filtered by each net was estimated by flow meters. Plankton samples were preserved in 5% formalin.

## Results

During the survey, 5 transects were sampled and 35 trawl stations were completed beginning at the southern end of the 166 ºW longitude line and ending on the southern end of the 162 ºW longitude line[2] (Figure 1). A total of 1,802 salmon representing 5 species were captured (Table 4). The largest component of the catch was juvenile salmon

[1] Reference to trade names does not imply endoresement by the National Marine Fisheries Service, NOAA.
[2] We were unable to sample on August 28 and 29 due to an unexpected storm. Therefore, the 161 ºW transect was not sampled during the survey.

including sockeye (73%), chum (12%), coho (5%), pink (<1%), and chinook (1%) salmon. Immature chum, sockeye, and chinook salmon comprised less than 8% of the catch each. Maturing pink, chum, sockeye, and coho salmon comprised less than 3% of the catch each. Other species captured during the survey are listed in Table 5.

Salmon distribution within our survey varied depending on species and life history stage. Juvenile sockeye salmon were mainly distributed in the middle domain of the eastern Bering Sea east of 166 ºW (Figure 2a). The largest concentrations of juvenile sockeye salmon occurred along the 164 ºW longitude line. Juvenile chum salmon were mainly distributed within the coastal domain of the eastern Bering Sea (Figure 2b). The largest concentration of juvenile chum salmon occurred south and west of the Kuskokwim River between 163 ºW and 164 ºW. Juvenile coho and chinook salmon were located near the coast within the coastal domain; the largest catch of juvenile coho occurred near Izembek Lagoon, whereas the largest catch of juvenile chinook occurred near Cape Newenham (Figures 2c and d). Immature chum and sockeye salmon were generally distributed west of 162 ºW with the largest concentrations of both species occurring in the oceanic domain near the 200 m edge (Figures 3a and b). Only five immature chinook salmon were caught during the cruise; all were captured within the middle domain along the 164 ºW transect (Figure 3c.) There was no particular pattern to the distribution of maturing pink or chum salmon caught during the cruise (Figures 4a and b), whereas, maturing coho were all distributed nearshore on the southern end of the survey (Figure 4c).

Body size of juvenile salmon increased with distance offshore and as fish migrated westward (Table 6). Juvenile sockeye salmon were generally larger along the 164 ºW line than along either the 163 ºW or 162 ºW. The largest juvenile sockeye salmon along the 164 ºW and 163 ºW line occurred near 56 30 ºN; juvenile sockeye salmon size generally decreased both north and south of this location along both longitudinal lines. Juvenile chum and coho salmon in the northern end of our survey were larger along the 165 ºW line than along the 164 ºW line. Juvenile chum salmon found in the southern end of our survey tended to be larger than those found in the northern end.

Oceanographic observations of sea surface temperatures varied little between domains. Sea surface temperatures were warmest in the coastal domain (average 10.4 C ± 0.8) and slightly cooler in the middle domain (average 9.7 C ± 0.8).

## Discussion

Juvenile sockeye salmon from all river systems entering Bristol Bay follow the same southwesterly seaward migration route along the coastal waters of the eastern Bering Sea (Straty 1974; Straty and Jaenicke 1980; and Straty 1981). The seasonal timing of this migration can be influenced by annual differences in environmental conditions, such as time of ice breakup on lakes and anomalously cold sea temperatures (Straty 1981). Our previous survey during September 1999 occurred after a cold spring in the eastern Bering Sea, which was characterized by a delay in the breakup of lake-ice in sockeye salmon nursery lakes and anomalously cold sea temperatures (Farley et al. 1999). In contrast, this year's survey followed relatively warm spring and summer temperatures and earlier timing of lake-ice breakup than during 1999.

The warmer spring and summer temperatures during 2000 may be related to our observations of increased sea surface temperatures in the middle domain and earlier offshore migrations of juvenile salmon away from coastal waters. During July 1999, juvenile sockeye salmon were mainly distributed in the coastal domain; we speculated that these salmon had not migrated further offshore into the middle domain due to cold surface temperatures (<6.0 ºC) within the middle domain (Farley et al. 1999). By September 1999, surface temperatures had warmed considerably in the middle domain (>9.0 C) and juvenile sockeye salmon encountered westward of 160 ºW were distributed throughout both the coastal and middle domains (Farley et al. 1999). Nearly all of the juvenile sockeye salmon encountered during August 2000, however were found in middle domain waters, possibly due to the warmer sea surface temperatures encountered in the middle domain earlier in the year.

Differences in habitat occupied by juvenile sockeye salmon in the eastern Bering Sea may influence early marine growth. For example, zooplankton densities have been found to be significantly less in the coastal domain than in the middle domain (Straty and Jaenicke 1980). A visual scan of early marine scale growth for age 1.0 and 2.0 sockeye salmon indicated that juvenile salmon captured during late August 2000 had more early marine growth than those captured during early September 1999 (personal communication, Jack Helle, Auke Bay Laboratory, Juneau, AK 99801). Juvenile sockeye salmon caught during the August 2000 survey were also significantly larger those caught during the September 1999 survey ($t = 2.576$; $p<0.01$). Thus, it is quite possible that the increased early marine growth of juvenile sockeye salmon observed in August 2000 is due to increased sea temperatures promoting accelerated migration westward and offshore where zooplankton densities are greater.

There is presently no information on the early marine migration or distribution of juvenile chum salmon from the Kuskokwim River. During the August 2000 survey, we found a small number of juvenile chum salmon within the coastal domain southwest of the Kuskokwim River. Whether these salmon illustrate the migratory route of juvenile chum salmon from the Kuskokwim River into the eastern Bering Sea is highly speculative.

Further sampling north, south, and east of Nunivak Island will be needed to help determine migratory pathways for these juvenile salmon.

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Table 1. Cruise itinerary for the August 20 – September 2, 2000 juvenile salmon survey in the coastal waters of the eastern Bering Sea.

| Date | Location/Activity |
|---|---|
| 20-August | Depart Dutch Harbor, enroute 166 ºW and begin sampling |
| 21-August | Continue sampling north along 166 ºW |
| 22-August | Continue sampling along 166 ºW; enroute 165 ºW |
| 23-August | Begin sampling south along 165 ºW; enroute 164 ºW and begin sampling |
| 24-August | Continue sampling south along 164 ºW |
| 25-August | Continue sampling south along 164 ºW; enroute 163 ºW |
| 26-August | Begin sampling north along 163 ºW |
| 27-August | Continue sampling north along 163 ºW; enroute 162 ºW |
| 28-August | Begin sampling south along 162 ºW |
| 29-August | Continue sampling south along 162 ºW; enroute 161 ºW |
| 30-August | Begin sampling north along 161 ºW |
| 31-August | Continue sampling north along 161 ºW; enroute Dutch Harbor |
| 1-September | Enroute Dutch Harbor |
| 2-September | Arrive Dutch Harbor, unload scientists and gear |

Table 2. Participating scientists for the August 20 – September 2, 2000 juvenile salmon surveys in the coastal waters of the eastern Bering Sea.

| Scientist | Agency |
|---|---|
| Edward V. Farley, Jr. (Chief Scientist) | Auke Bay Laboratory, AFSC, NMFS |
| Richard E. Haight | Auke Bay Laboratory, AFSC, NMFS |
| Charles M. Guthrie, III. | Auke Bay Laboratory, AFSC, NMFS |
| John E. Pohl | Auke Bay Laboratory, AFSC, NMFS |

Table 3. Haul information for the August 20 - September 2, 2000 juvenile salmon survey in the eastern Bering Sea.

| Date | Lat N | Lon W | Course | Start Time | Speed (Knots) | Vertical (m) | orizontal (m) | Warp (m) | Domain | SST |
|---|---|---|---|---|---|---|---|---|---|---|
| 8/20 | 54.14 | 165.59 | 0 | 9:01 | 5 | 11.0 | 43.9 | 366 | Coastal | 9.3 |
| 8/20 | 54.30 | 166.00 | 0 | 11:58 | 3.4 | 11.9 | 43.9 | 366 | Outer | 10 |
| 8/20 | 54.46 | 166.00 | 0 | 15:20 | 3.9 | 12.8 | 43.9 | 366 | Outer | 9.7 |
| 8/20 | 55.30 | 166.00 | 0 | 21:05 | 4.4 | 11.0 | 43.9 | 366 | Outer | 11.3 |
| 8/21 | 56.19 | 166.01 | 0 | 9:09 | 4.4 | 11.0 | 43.9 | 366 | Middle | 10.3 |
| 8/21 | 56.59 | 165.59 | 0 | 15:48 | 4 | 12.8 | 42.1 | 366 | Middle | 9.5 |
| 8/21 | 57.30 | 166.01 | 0 | 21:17 | 4.5 | 11.9 | 43.9 | 366 | Middle | 9.2 |
| 8/22 | 58.30 | 166.01 | 0 | 8:22 | 4.3 | 10.1 | 44.8 | 366 | Inner | 8 |
| 8/22 | 58.59 | 166.01 | 0 | 12:17 | 4.9 | 11.9 | 43.9 | 366 | Coastal | 9.4 |
| 8/22 | 59.30 | 165.59 | 0 | 16:00 | 4.4 | 10.1 | 44.8 | 366 | Coastal | 10 |
| 8/22 | 59.46 | 166.00 | 180 | 18:35 | 4.4 | 10.1 | 45.7 | 366 | Coastal | 10.9 |
| 8/23 | 59.22 | 165.01 | 180 | 8:40 | 4.6 | 11.9 | 43.9 | 366 | Coastal | 10.7 |
| 8/23 | 59.00 | 165.01 | 180 | 11:53 | 4.1 | 9.1 | 44.8 | 366 | Coastal | 9.6 |
| 8/23 | 59.29 | 164.00 | 180 | 17:48 | 5.1 | 8.8 | 45.7 | 366 | Coastal | 11.7 |
| 8/23 | 58.59 | 164.01 | 180 | 21:18 | 5.3 | 10.1 | 45.7 | 366 | Coastal | 10.7 |
| 8/24 | 58.30 | 164.01 | 180 | 8:12 | 4.9 | 10.1 | 44.8 | 366 | Coastal | 9.1 |
| 8/24 | 58.00 | 164.01 | 180 | 12:12 | 4.4 | 11.9 | 43.9 | 366 | Inner | 9 |
| 8/24 | 57.32 | 163.59 | 0 | 16:29 | 4.6 | 11.0 | 43.9 | 366 | Middle | 9.7 |
| 8/24 | 57.00 | 163.59 | 180 | 21:14 | 4.6 | 11.9 | 43.9 | 366 | Middle | 10.5 |
| 8/25 | 56.30 | 164.01 | 180 | 8:24 | 4.7 | 11.0 | 43.9 | 366 | Middle | 10.1 |
| 8/25 | 56.00 | 164.00 | 180 | 12:27 | 4.6 | 11.0 | 43.9 | 366 | Middle | 10.7 |
| 8/25 | 55.31 | 164.00 | 180 | 16:42 | 4.1 | 11.9 | 43.9 | 366 | Middle | 10.4 |
| 8/25 | 54.59 | 164.06 | 0 | 21:01 | 4.6 | 10.1 | 45.7 | 366 | Coastal | 9.7 |
| 8/26 | 55.18 | 163.01 | 0 | 8:12 | 4.1 | 11.9 | 42.1 | 366 | Coastal | 10.8 |
| 8/26 | 55.30 | 163.01 | 0 | 11:30 | 4.2 | 9.1 | 45.7 | 366 | Inner | 10.7 |
| 8/26 | 55.59 | 163.00 | 0 | 15:50 | 4.5 | 11.9 | 42.1 | 366 | Middle | 10.5 |
| 8/26 | 56.30 | 162.59 | 0 | 20:07 | 4.7 | 11.0 | 43.9 | 366 | Middle | 10.3 |
| 8/27 | 57.00 | 163.00 | 0 | 8:25 | 4.7 | 11.0 | 43.9 | 366 | Middle | 9.5 |
| 8/27 | 57.30 | 163.01 | 0 | 12:45 | 4.2 | 11.0 | 43.9 | 366 | Middle | 9.8 |
| 8/27 | 58.00 | 163.01 | 0 | 17:02 | 4.9 | 11.0 | 43.9 | 366 | Inner | 9.6 |
| 8/30 | 58.36 | 162.01 | 180 | 16:20 | 4.4 | 11.0 | 43.9 | 366 | Coastal | 10.7 |
| 8/30 | 58.00 | 162.00 | 180 | 21:25 | 4.4 | 11.0 | 43.9 | 366 | Inner | 9 |
| 8/31 | 57.01 | 162.00 | 180 | 8:35 | 4.2 | 11.0 | 43.9 | 366 | Middle | 8.3 |
| 8/31 | 56.31 | 161.59 | 180 | 13:31 | 4.5 | 11.0 | 43.9 | 366 | Middle | 8.7 |
| 8/31 | 56.00 | 162.01 | 180 | 17:52 | 4.7 | 11.0 | 43.9 | 366 | Inner | 9.9 |

Table 4. Total catch of juvenile (J), immature (I), and adult (A) salmon by species and location by the F/V *Great Pacific* in the eastern Bering Sea during August 20 - September 2, 2000. Dash (-) indicates no salmon caught.

| Date | Lat N | Lon W | Pink | | Chum | | | Sockeye | | | Coho | | Chinook | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | J | A | J | I | A | J | I | A | J | A | J | I | A |
| 8/20 | 54.14 | 165.59 | 1 | 6 | - | 36 | 3 | 3 | 7 | - | - | - | - | - | - |
| 8/20 | 54.30 | 166.00 | - | 1 | - | 10 | - | - | 19 | - | - | - | - | - | - |
| 8/20 | 54.46 | 166.00 | - | - | - | 1 | - | - | 3 | - | - | - | - | - | - |
| 8/20 | 55.30 | 166.00 | - | - | - | 11 | - | - | - | - | - | - | - | - | - |
| 8/21 | 56.19 | 166.01 | - | - | - | 11 | - | 7 | - | - | - | - | - | - | - |
| 8/21 | 56.59 | 165.59 | - | - | - | 5 | 1 | 2 | - | - | - | - | - | - | - |
| 8/21 | 57.30 | 166.01 | - | - | - | 1 | 1 | - | - | - | - | - | - | - | - |
| 8/22 | 58.30 | 166.01 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/22 | 58.59 | 166.01 | - | - | - | - | - | 3 | - | - | 1 | - | - | - | - |
| 8/22 | 59.30 | 165.59 | - | - | - | - | - | 7 | - | - | - | - | - | - | - |
| 8/22 | 59.46 | 166.00 | - | - | 1 | - | - | 11 | - | - | 1 | - | - | - | - |
| 8/23 | 59.22 | 165.01 | - | - | 17 | - | - | 2 | - | - | 15 | - | - | - | - |
| 8/23 | 59.00 | 165.01 | - | - | - | - | - | 13 | - | - | 1 | - | - | - | - |
| 8/23 | 59.29 | 164.00 | - | - | 11 | - | - | - | - | - | 7 | - | - | - | - |
| 8/23 | 58.59 | 164.01 | - | - | 163 | - | - | - | - | - | 6 | - | 2 | - | - |
| 8/24 | 58.30 | 164.01 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/24 | 58.00 | 164.01 | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 8/24 | 57.32 | 163.59 | - | - | - | - | - | 5 | - | - | - | - | - | - | - |
| 8/24 | 57.00 | 163.59 | - | 1 | - | - | - | 16 | - | - | - | - | - | 3 | - |
| 8/25 | 56.30 | 164.01 | - | 1 | - | 4 | 1 | 166 | - | - | - | - | 1 | 1 | - |
| 8/25 | 56.00 | 164.00 | - | - | - | 3 | - | 243 | - | - | - | - | - | - | - |
| 8/25 | 55.31 | 164.00 | - | - | - | 4 | - | 267 | 2 | - | - | - | - | - | - |
| 8/25 | 54.59 | 164.06 | - | 1 | - | - | - | - | - | - | 1 | 1 | - | 1 | - |
| 8/26 | 55.18 | 163.01 | - | - | 1 | - | 2 | - | - | - | 47 | 1 | - | - | - |
| 8/26 | 55.30 | 163.01 | - | 1 | 14 | - | - | 63 | 1 | - | 3 | - | - | - | - |
| 8/26 | 55.59 | 163.00 | - | - | 1 | 1 | - | 81 | - | - | - | - | - | - | - |
| 8/26 | 56.30 | 162.59 | - | - | - | - | - | 97 | - | - | - | - | - | - | - |
| 8/27 | 57.00 | 163.00 | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 8/27 | 57.30 | 163.01 | - | - | - | - | 1 | 95 | - | - | - | - | - | - | - |
| 8/27 | 58.00 | 163.01 | - | - | - | - | - | 152 | - | - | - | - | - | - | - |
| 8/30 | 58.36 | 162.01 | - | - | 4 | - | - | | - | - | - | - | 19 | - | - |
| 8/30 | 58.00 | 162.00 | - | - | - | - | - | 8 | - | - | - | - | 5 | - | - |
| 8/31 | 57.01 | 162.00 | - | - | - | - | - | 18 | - | - | - | - | - | - | - |
| 8/31 | 56.31 | 161.59 | - | - | 4 | - | 1 | 61 | - | - | - | - | - | - | - |
| 8/31 | 56.00 | 162.01 | - | - | 7 | - | - | - | - | - | - | - | - | - | - |

Table 5. Total catch of marine fishes by species and location by the F/V *Great Pacific* in the eastern Bering Sea during August 20 - September 2, 2000. Dash (-) indicates no marine fish caught.

| Date | Lat N | Lon W | Herring | Capelin | Sand-lance | Bering olffish | Atka Mack | Prow-fish | Crested Sculpin | ainbow Smelt | Arctic Lamprey | 3-spine Stick | Sturgeon Poacher |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/20 | 54.14 | 165.59 | 4 | - | 1,000 | 9 | 7 | - | - | - | - | - | - |
| 8/20 | 54.30 | 166.00 | 1 | - | 500 | 4 | - | - | - | - | - | - | - |
| 8/20 | 54.46 | 166.00 | 5 | - | 20 | 9 | - | - | - | - | - | - | - |
| 8/20 | 55.30 | 166.00 | 2 | - | - | 18 | - | 18 | 7 | - | - | - | - |
| 8/21 | 56.19 | 166.01 | - | - | - | 21 | 1 | - | 4 | - | - | - | - |
| 8/21 | 56.59 | 165.59 | 500 | - | - | 6 | - | - | 1 | - | - | - | - |
| 8/21 | 57.30 | 166.01 | 1,000 | - | - | 2 | - | - | - | - | - | - | - |
| 8/22 | 58.30 | 166.01 | - | - | - | 4 | - | - | - | - | - | - | - |
| 8/22 | 58.59 | 166.01 | - | 1,000 | 100 | 3 | - | - | - | 1 | 1 | - | - |
| 8/22 | 59.30 | 165.59 | - | - | 300 | - | - | - | - | - | - | - | - |
| 8/22 | 59.46 | 166.00 | - | - | 200 | - | - | - | - | - | - | - | 1 |
| 8/23 | 59.22 | 165.01 | 71 | - | 600 | 3 | - | - | - | 125 | 1 | - | - |
| 8/23 | 59.00 | 165.01 | 4 | - | 200 | 2 | - | - | - | 5 | - | - | - |
| 8/23 | 59.29 | 164.00 | - | - | - | 4 | - | - | - | - | 1 | 100 | - |
| 8/23 | 58.59 | 164.01 | 23 | - | - | 10 | - | - | - | - | 2 | - | - |
| 8/24 | 58.30 | 164.01 | - | - | 400 | 25 | - | - | - | - | - | - | - |
| 8/24 | 58.00 | 164.01 | 38 | 700 | - | 21 | - | - | - | - | - | - | - |
| 8/24 | 57.32 | 163.59 | 37 | 1,000 | - | 21 | - | - | - | - | - | - | 1 |
| 8/24 | 57.00 | 163.59 | 5,096 | - | - | 16 | - | - | - | - | - | - | - |
| 8/25 | 56.30 | 164.01 | - | - | - | 12 | - | - | - | - | - | - | - |
| 8/25 | 56.00 | 164.00 | - | - | - | 5 | - | 9 | 3 | - | - | - | - |
| 8/25 | 55.31 | 164.00 | - | - | - | 20 | - | 1 | 3 | - | - | - | - |
| 8/25 | 54.59 | 164.06 | 1 | - | - | - | - | - | - | - | - | - | - |
| 8/26 | 55.18 | 163.01 | 3 | - | - | 2 | - | 38 | - | 1 | - | - | 1 |
| 8/26 | 55.30 | 163.01 | - | - | - | 5 | - | - | 1 | - | - | - | - |
| 8/26 | 55.59 | 163.00 | - | - | - | 2 | - | 5 | 4 | - | - | - | - |
| 8/26 | 56.30 | 162.59 | 3 | - | - | 4 | - | - | - | - | - | - | - |
| 8/27 | 57.00 | 163.00 | 354 | - | - | 11 | - | - | 1 | - | - | - | - |
| 8/27 | 57.30 | 163.01 | 116 | - | - | 15 | - | - | - | - | - | - | - |
| 8/27 | 58.00 | 163.01 | 14 | - | - | 16 | - | - | - | - | - | - | - |
| 8/30 | 58.36 | 162.01 | 114 | - | - | 14 | - | - | - | 1,360 | - | - | - |
| 8/30 | 58.00 | 162.00 | 232 | 1,500 | - | 2 | - | - | - | - | - | - | 1 |
| 8/31 | 57.01 | 162.00 | 638 | - | - | 10 | - | - | - | - | - | - | - |
| 8/31 | 56.31 | 161.59 | 13 | - | - | 2 | - | - | - | - | - | - | - |
| 8/31 | 56.00 | 162.01 | - | - | - | 17 | 5 | 2 | 6 | - | - | - | - |

Table 5. (Con't) Total catch of marine fishes by species and location by the F/V *Great Pacific* in the eastern Bering Sea during August 20 - September 2, 2000. Dash (-) indicates no marine fish caught.

| Date | Lat N | Lon W | Sandfish | | Pollock | | | Juv. P. | YF | AK | Starry | Rock |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | J | A | J | 1yr | A | Cod | Sole | Plaice | lounder | Sole |
| 8/20 | 54.14 | 165.59 | - | - | - | - | - | - | - | - | - | - |
| 8/20 | 54.30 | 166.00 | - | - | 2 | - | - | - | - | - | - | - |
| 8/20 | 54.46 | 166.00 | - | - | 4 | - | - | - | - | - | - | - |
| 8/20 | 55.30 | 166.00 | - | - | 5,000 | - | - | 500 | - | - | - | - |
| 8/21 | 56.19 | 166.01 | - | - | 5,000 | - | 1 | 1,000 | - | - | - | - |
| 8/21 | 56.59 | 165.59 | - | - | - | 5,000 | - | - | 3 | - | - | - |
| 8/21 | 57.30 | 166.01 | - | - | - | - | 1 | - | - | - | - | - |
| 8/22 | 58.30 | 166.01 | - | - | 1,000 | - | - | - | 7 | - | - | - |
| 8/22 | 58.59 | 166.01 | - | - | 1 | - | - | - | 1 | - | - | - |
| 8/22 | 59.30 | 165.59 | - | - | - | - | - | - | - | 1 | - | - |
| 8/22 | 59.46 | 166.00 | - | - | - | - | 2 | - | - | - | - | - |
| 8/23 | 59.22 | 165.01 | - | 1 | - | - | 1 | 129 | 1 | - | - | - |
| 8/23 | 59.00 | 165.01 | - | - | - | - | 1 | - | - | - | - | - |
| 8/23 | 59.29 | 164.00 | - | 1 | - | - | 1 | 1 | - | - | 1 | - |
| 8/23 | 58.59 | 164.01 | - | - | - | - | - | - | 10 | - | - | 3 |
| 8/24 | 58.30 | 164.01 | - | 3 | 500 | - | - | - | 24 | - | - | 1 |
| 8/24 | 58.00 | 164.01 | - | 3 | 100 | - | - | - | 4 | - | - | - |
| 8/24 | 57.32 | 163.59 | - | 5 | 3,000 | - | - | - | - | - | - | - |
| 8/24 | 57.00 | 163.59 | - | 5 | 3,000 | - | - | - | 4 | - | - | - |
| 8/25 | 56.30 | 164.01 | - | - | 10,000 | 50 | - | - | 1 | - | - | - |
| 8/25 | 56.00 | 164.00 | - | 1 | 1,000 | - | - | 500 | - | - | - | - |
| 8/25 | 55.31 | 164.00 | 10,000 | 24 | - | - | 1 | - | - | - | - | - |
| 8/25 | 54.59 | 164.06 | - | 2,000 | - | - | - | - | - | - | - | - |
| 8/26 | 55.18 | 163.01 | - | 4 | - | - | - | - | 1 | - | - | - |
| 8/26 | 55.30 | 163.01 | 8,000 | 20 | 2,000 | - | - | 700 | - | - | - | - |
| 8/26 | 55.59 | 163.00 | - | 1 | 4,000 | - | 1 | 500 | - | - | - | - |
| 8/26 | 56.30 | 162.59 | - | 13 | 1,000 | - | - | 200 | 1 | - | - | - |
| 8/27 | 57.00 | 163.00 | - | 7 | 1,000 | - | - | - | 1 | - | - | - |
| 8/27 | 57.30 | 163.01 | - | 1 | 700 | - | - | - | 2 | - | - | - |
| 8/27 | 58.00 | 163.01 | - | 2 | 500 | 1 | - | - | 3 | - | - | - |
| 8/30 | 58.36 | 162.01 | 500 | 16 | - | 10 | - | - | 2 | 2 | 3 | - |
| 8/30 | 58.00 | 162.00 | - | 6 | 700 | - | - | - | 2 | - | - | - |
| 8/31 | 57.01 | 162.00 | - | 8 | 2,000 | - | - | - | 13 | - | - | - |
| 8/31 | 56.31 | 161.59 | - | 27 | 4,000 | - | - | - | 3 | - | - | - |
| 8/31 | 56.00 | 162.01 | 1,000 | - | 500 | - | 1 | - | 11 | - | - | - |

Table 6. Length (L), weight (W), and number sampled (*n* ) for juvenile chum, sockeye, and coho salmon caught by the F/V *Great Pacific* in the eastern Bering Sea during August 20 - September 2, 2000. (std is the standard deviation).

| | | | Chum | | | | | Sockeye | | | | | Coho | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Lat N | Lon W | *n* | L (mm) | std | W (g) | std | *n* | L (mm) | std | W (g) | std | *n* | L (mm) | std | W (g) | std |
| 8/20 | 54.14 | 165.59 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/20 | 54.30 | 166.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/20 | 54.46 | 166.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/20 | 55.30 | 166.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/21 | 56.19 | 166.01 | - | - | - | - | - | 7 | 240 | 34.2 | 154 | 71.5 | - | - | - | - | - |
| 8/21 | 56.59 | 165.59 | - | - | - | - | - | 2 | 214 | 9.9 | 102 | 13.4 | - | - | - | - | - |
| 8/21 | 57.30 | 166.01 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/22 | 58.30 | 166.01 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/22 | 58.59 | 166.01 | - | - | - | - | - | 3 | 150 | 2.1 | 34 | 1.5 | 1 | 196 | - | 93 | - |
| 8/22 | 59.30 | 165.59 | - | - | - | - | - | 7 | 157 | 3.8 | 40 | 3 | - | - | - | - | - |
| 8/22 | 59.46 | 166.00 | 1 | 175 | - | 54 | - | 11 | 164 | 6.2 | 48 | 4.8 | 1 | 315 | - | 409 | - |
| 8/23 | 59.22 | 165.01 | 17 | 151 | 10.9 | 34 | 7.3 | 2 | 132 | 2.1 | 21 | 2.1 | 15 | 264 | 15.3 | 238 | 43.7 |
| 8/23 | 59.00 | 165.01 | - | - | - | - | - | 13 | 157 | 14.2 | 42 | 11.4 | 1 | 209 | - | 111 | - |
| 8/23 | 59.29 | 164.00 | 11 | 139 | 11.9 | 28.1 | 8.3 | - | - | - | - | - | 7 | 217 | 13.6 | 127 | 20.3 |
| 8/23 | 58.59 | 164.01 | 20 | 147 | 9.5 | 34 | 6.7 | - | - | - | - | - | 6 | 251 | 19.5 | 199 | 50 |
| 8/24 | 58.30 | 164.01 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8/24 | 58.00 | 164.01 | - | - | - | - | - | 1 | 175 | - | 55 | - | - | - | - | - | - |
| 8/24 | 57.32 | 163.59 | - | - | - | - | - | 5 | 176 | 8.3 | 56 | 9.4 | - | - | - | - | - |
| 8/24 | 57.00 | 163.59 | - | - | - | - | - | 16 | 186 | 6.7 | 62 | 8.9 | - | - | - | - | - |
| 8/25 | 56.30 | 164.01 | - | - | - | - | - | 50 | 198 | 10.8 | 78 | 14.5 | - | - | - | - | - |
| 8/25 | 56.00 | 164.00 | - | - | - | - | - | 50 | 196 | 10.5 | 75 | 14.2 | - | - | - | - | - |
| 8/25 | 55.31 | 164.00 | - | - | - | - | - | 50 | 180 | 14.9 | 58 | 14.5 | - | - | - | - | - |
| 8/25 | 54.59 | 164.06 | - | - | - | - | - | - | - | - | - | - | 1 | 220 | - | 136 | - |
| 8/26 | 55.18 | 163.01 | 1 | 174 | - | 52 | - | - | - | - | - | - | 20 | 249 | 19.7 | 200 | 48.7 |
| 8/26 | 55.30 | 163.01 | 14 | 159 | 12.9 | 42 | 8.9 | 25 | 164 | 12 | 43 | 11.1 | 3 | 287 | 12.1 | 311 | 37.4 |
| 8/26 | 55.59 | 163.00 | 1 | 147 | - | 27 | - | 50 | 157 | 16.9 | 39 | 15.4 | - | - | - | - | - |
| 8/26 | 56.30 | 162.59 | - | - | - | - | - | 26 | 181 | 10.3 | 58 | 10.9 | - | - | - | - | - |
| 8/27 | 57.00 | 163.00 | - | - | - | - | - | 1 | 170 | - | 45 | - | - | - | - | - | - |
| 8/27 | 57.30 | 163.01 | - | - | - | - | - | 25 | 166 | 5.9 | 47 | 6.5 | - | - | - | - | - |
| 8/27 | 58.00 | 163.01 | - | - | - | - | - | 34 | 182 | 9.8 | 63 | 12.3 | - | - | - | - | - |
| 8/30 | 58.36 | 162.01 | 4 | 130 | 14.6 | 23 | 9.1 | - | - | - | - | - | - | - | - | - | - |
| 8/30 | 58.00 | 162.00 | - | - | - | - | - | 8 | 181 | 13.4 | 65 | 15.5 | - | - | - | - | - |
| 8/31 | 57.01 | 162.00 | - | - | - | - | - | 18 | 168 | 7.8 | 47 | 8.7 | - | - | - | - | - |
| 8/31 | 56.31 | 161.59 | 4 | 172 | 3.4 | 51 | 2.2 | 25 | 156 | 19 | 38 | 15.5 | - | - | - | - | - |
| 8/31 | 56.00 | 162.01 | 7 | 117 | 13.4 | 16 | 5.1 | - | - | - | - | - | - | - | - | - | - |

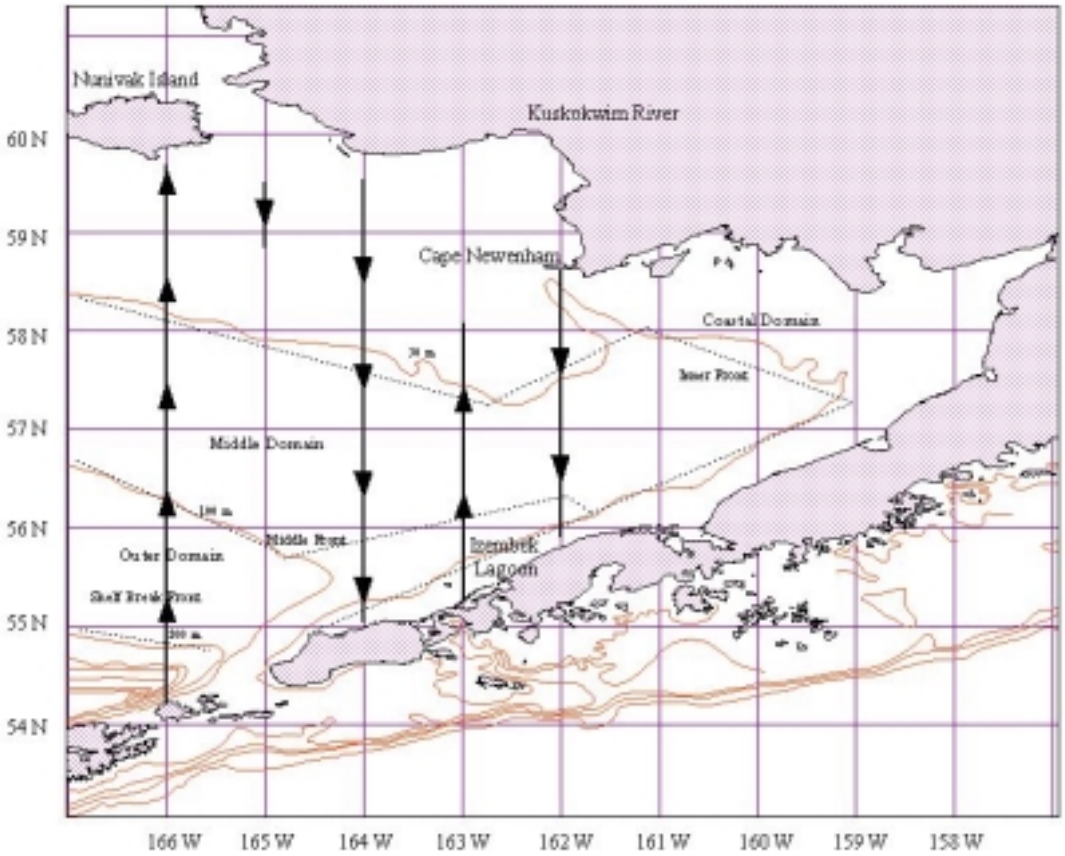


Figure 1. Transects (Dark lines along 166 W to 162 W) sampled by the NMPS OCC program in the eastern Bering Sea August 20 - September 2, 2000. Frontal zones are indicated by dashed lines. The Coastal Domain is shoreward of the 50 m contour; the Middle Domain is the area between the 50 m and 100 m contours; the Outer Domain is the area between the 100 m and 200 m contours.

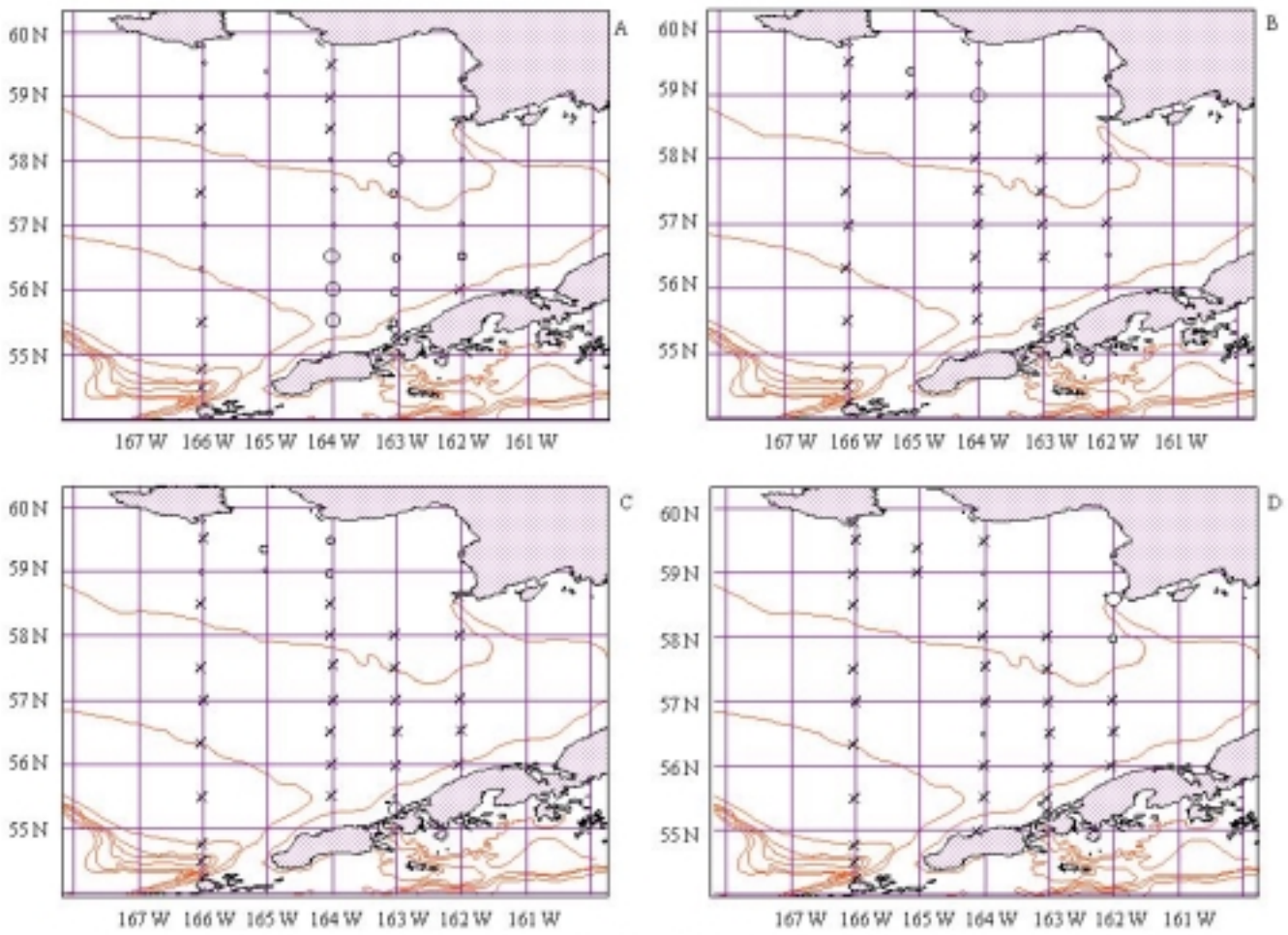


Figure 2. Distribution of juvenile sockeye (A), chum (B), coho (C), and chinook (D) salmon captured by the F/V Great Pacific during August 20 - September 2, 2000 in the eastern Bering Sea. Circles (O) indicate sampling stations where juvenile salmon were caught; larger circles indicate greater catch (see Table 4 for actual numbers caught at each station). X indicates sampling stations where no juvenile salmon were caught.

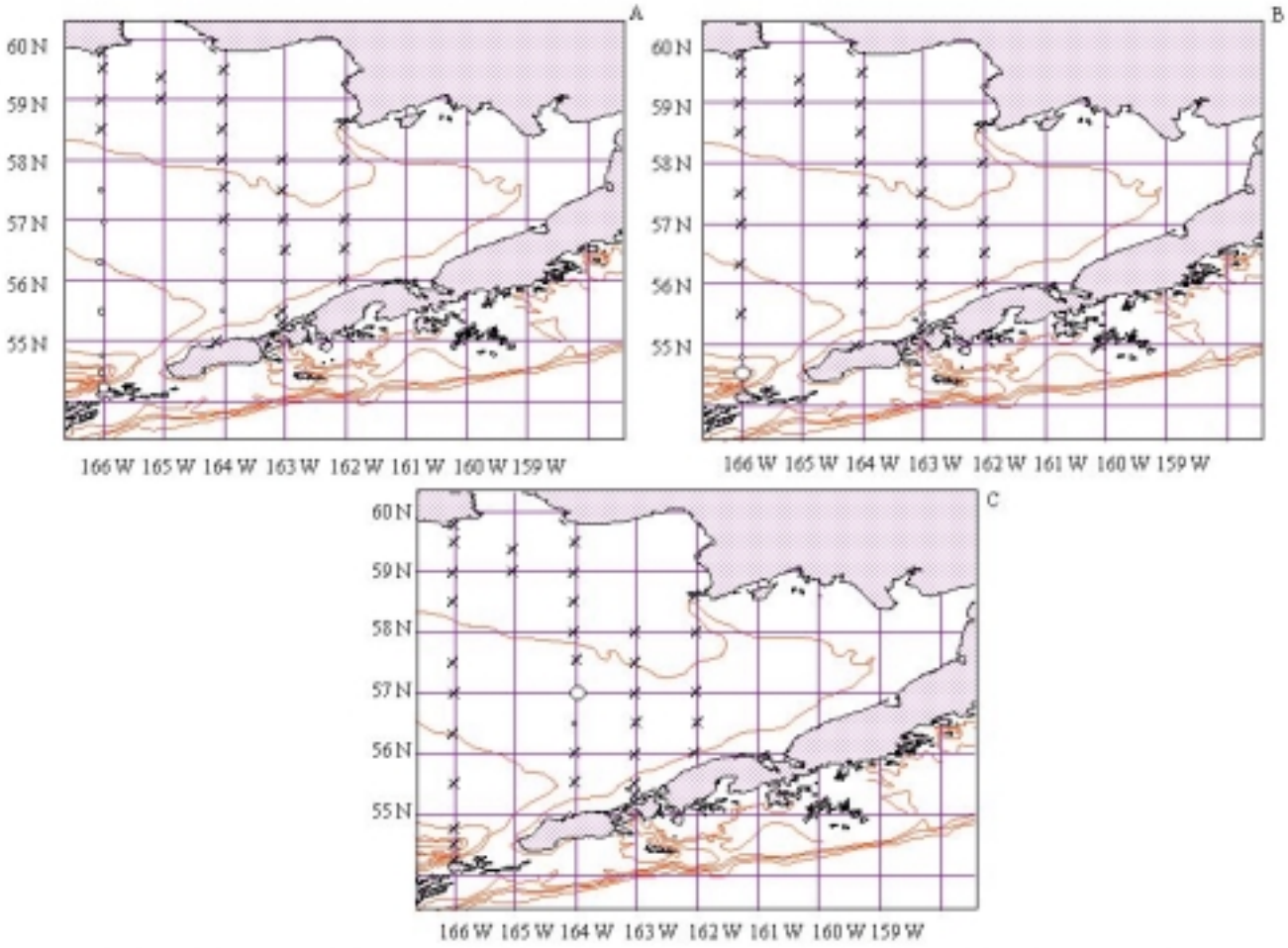


Figure 3. Distribution of immature chum (A), sockeye (B), and chinook (C) salmon captured by the F/V Great Pacific during August 20 - September 2, 2000 in the eastern Bering Sea. Circles (O) indicate sampling stations where immature salmon were caught; larger circles indicate greater catch (see Table 4 for actual numbers caught at each station). X indicates sampling stations where no immature salmon were caught.

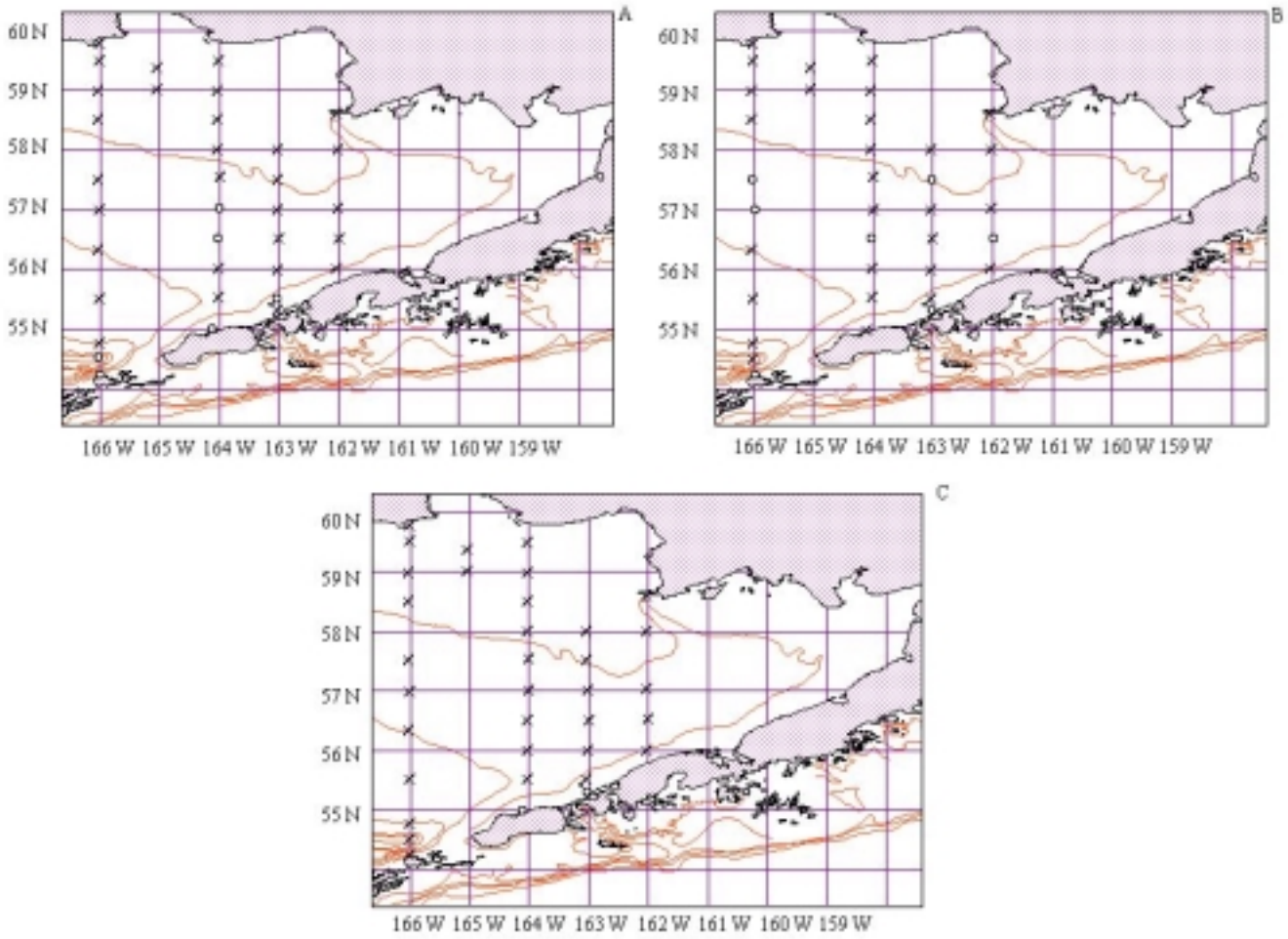


Figure 4. Distribution of mature pink (A), chum (B), and coho (C) salmon captured by the F/V Great Pacific during August 20 - September 2, 2000 in the eastern Bering Sea. Circles (O) indicate sampling stations where mature salmon were caught; larger circles indicate greater catch (see Table 4 for actual numbers caught at each station). X indicates sampling stations where no mature salmon were caught.